**Polynomial Functions - Building a Box**

Students are given an 18 X 12 “ piece of construction paper and told to build a box by cutting out congruent squares from two corners and congruent rectangles from the other two corners, then folding the sides to create their box.

Students are broken up into groups of 2 and each group is given a different side length to use for their congruent squares.

Square side lengths assigned: 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, and 5. If there are more groups than side lengths, start from 1 inch and again. Once the boxes are built, students compare the size of each box and guess which box has the greatest volume. They will then do the math to find the box with the maximum volume.

For example:

If the side length is 2”, the size of the corner cut out is 2” X 2”

The length of the box is 8”

The width of the box is 7”

The height of the box is 2”

The volume of the box is 112 in3

1. If the side lengths of the square are *x* inches, then

Length = 12 – 2*x* Height = *x* Width = = 9 – *x*

So volume = (12 – 2*x*)(9 – *x* )(*x* ) x-intercepts are x=0, 6, 9

2. In order to graph the function, students will need to consider their window settings. What are possible values for x in this situation? 0 < x < 6 (If we use 6, the volume will equal zero). For the variable y (the volume), 0 < y < 115 (the volume cannot be greater than or equal to 115). Go to Y= and type in the function in Y1.

3. Students will need the information from part 2 to answer this question. Looking at the x-intercepts will help them find the restrictions.

4. Students will need to go to their calculators to find the maximum point on the graph using 2nd, Trace, and maximum, then finding a point for the left bound and a point for the right bound.

The maximum point will be (2.35, 114.08). The side length needed to maximize the area is 2.35 inches and will result in a maximum area of 114.08 sq. inches.

5. Students can set the equation equal to 60 but will more than likely not be able to solve for x. They can find the solutions using the calculator by going to Y= and typing 60 in the Y2, then graphing. They can find the two intersection points by using 2nd, Trace, Intersection. The intersection points are (.6772, 60) and (4.518, 60).

**Pizza Box – Can be assigned for homework**

1. Length = 50 – 2(7) = 50 – 14 = 36 cm.

Width = 120 – 3(7) = 120 – 21 = 99 cm.

Height = 7 cm.

Volume = 36 \* 99 \* 7 = 24, 948 cm3

2. Length = 50 – 2(20) = 50 – 40 = 10 cm.

Width = 120 – 3(20) = 120 – 60 = 60 cm.

Height = 20 cm.

Volume = 10 \* 60 \* 20 = 12,000 cm3

3. Length = 50 – 2*x*

Width = 120 – 3*x*

Height = *x*

V(*x*) = (50 – 2*x*)(120 – 3*x*)(*x*)

4. Graph the function. They will have to adjust their windows to see the graph. Xmin= 0, Xmax= 30, X scl=2,

Ymin= 0, Ymax=27,100, Yscl= 1000

5. 0 < *x* < 25, if you use 25 for x, the volume will equal zero.

6. Graph y = 10,000 in Y2, then find the intersection points using the calculator. (1.893, 10,000) and

(20.826, 10,000)

7. To maximize the volume, students will use 2nd, Trace, and maximum to find the maximum width and volume. They can then substitute the width into the Length = 50 – 2*x* equation to find the value of the length.

Max volume = 27,000 cm3 Max width = 10 cm. Length = 30 cm.